



**WORK PLAN  
for an  
ECOLOGICAL ASSESSMENT OF THE ROCKAWAY RIVER  
L.E. CARPENTER  
WHARTON, NEW JERSEY SITE**

**JUNE 15, 1992**

**W.O. No.: 6720-03-01**

**Prepared for:**

**L.E. Carpenter  
1301 East 9th Street  
Suite 3600  
Cleveland, Ohio 44114-1824**

**Prepared by:**

**Roy F. Weston, Inc.  
Raritan Plaza I, 4th Floor  
Edison, New Jersey 08837**



## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1.0 Introduction	1-1
1.1 Purpose	1-1
1.2 Site Background	1-2
1.3 Existing Ecological Risk Assessment	1-5
1.4 Habitat Description	1-5
1.5 Project Objective	1-6
2.0 Investigative Strategy	2-1
2.1 Overview	2-1
2.2 Sample Locations	2-1
2.3 Habitat Assessment	2-3
2.3.1 In Situ Water Quality	2-3
2.3.2 Riparian and Instream Habitat	2-3
2.4 Macroinvertebrate Biological Survey	2-3
2.4.1 Introduction	2-3
2.4.2 Riffle Area Macroinvertebrate Field Methods	2-4
2.4.3 Coarse Particulate Organic Matter Macroinvertebrate Field Methods	2-4
2.4.4 Periphyton and Macrophyte Field Methods	2-4
2.4.5 Field Processing of Samples	2-5
2.4.6 Laboratory Processing of Macroinvertebrate Samples	2-5
2.4.7 Laboratory Processing of Periphyton Samples	2-6
2.5 Data Analysis	2-6
2.6 Quality Assurance	2-9
3.0 Project Schedule	3-1
4.0 References	4-1



## 1.0 INTRODUCTION

### 1.1 Purpose

This ecological assessment is being conducted to assure compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(b)(2), CERCLA as amended by Superfund Amendments and Reauthorization Act (SARA) Section 122(j)(1) and 122(j)(2), and the National Contingency Plan (NCP).

This ecological assessment of the Rockaway River will characterize the structure and function of the macroinvertebrate community in the area adjacent to the L.E. Carpenter Site. The ecological assessment is an evaluation in which empirical data is considered in concert with data available in the literature.

The ecological assessment will involve collection of biological data, including population abundance and diversity studies. Performance of the ecological assessment will follow accepted and approved methodology including:

- Rapid Bioassessment Protocols for use in Stream and Rivers, Benthic Macroinvertebrates and Fish (USEPA, 1989)
- Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters (USEPA, 1990)
- IERL-RTP Procedures Manual: Level I Environmental Assessment, Biological Tests (USEPA, 1981)
- Protocol for Bioassessment of Hazardous Waste Sites (USEPA, 1983)
- Review of Ecological Risk Assessment Methods (USEPA, 1988)
- Risk Assessment Guidance for Superfund - Volume II, Environmental Evaluation Manual (USEPA, 1989)
- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (USEPA, 1989)
- User's Manual for Ecological Risk Assessment (Oak Ridge, 1986)

Additional guidance was outlined in correspondence from the NJDEPE to L.E. Carpenter, dated 18 March 1992 and specific guidance regarding strategies and scope were discussed with NJDEPE personnel on 18 May 1992.

## 1.2 Site Background

A detailed description of the site history is provided in the "Revised Report of Remedial Investigation Findings" (June 1990). A summary of that information is provided in this report.

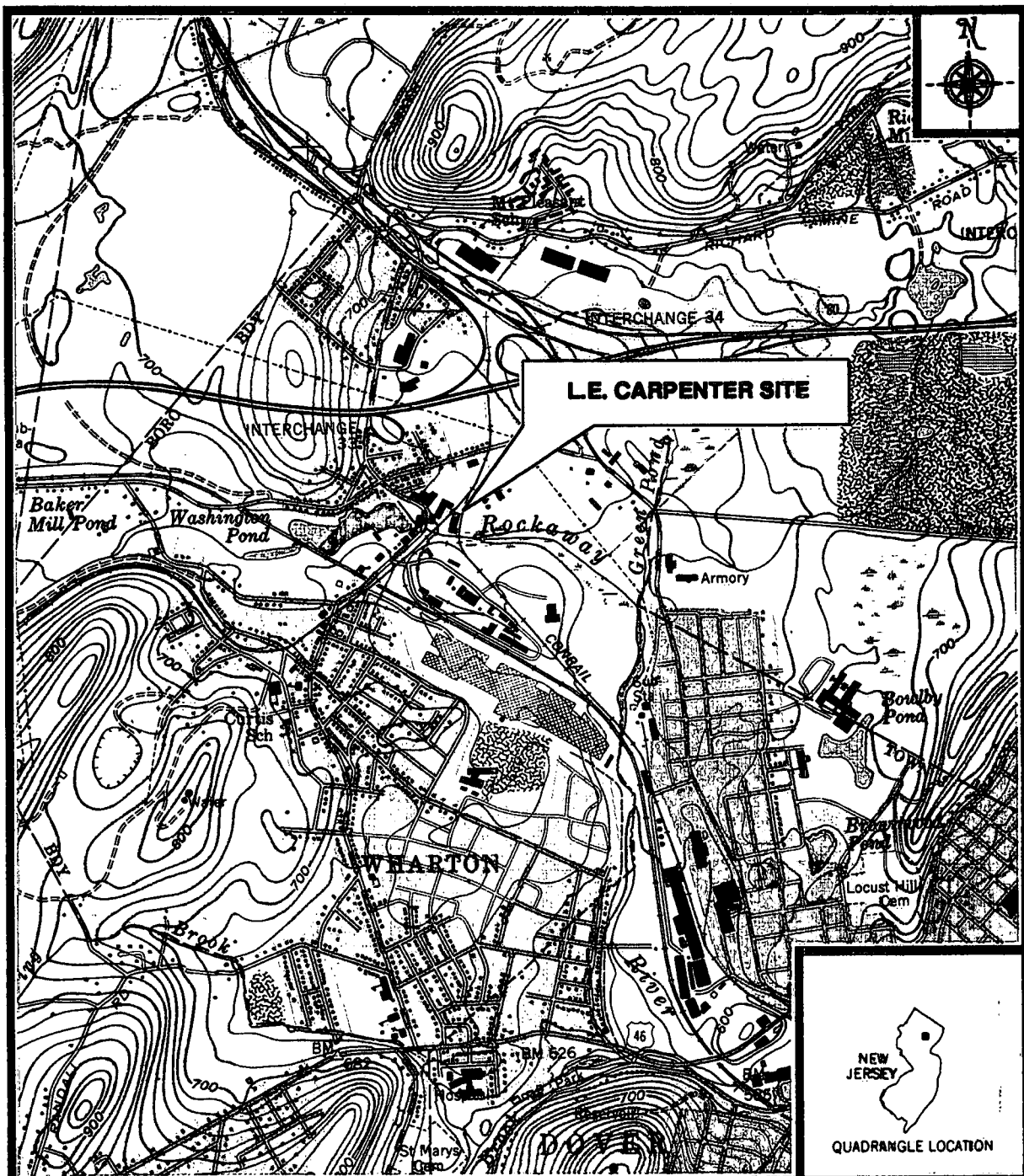
The L.E. Carpenter facility is located at 170 North Main Street, Borough of Wharton, Morris County, New Jersey. The location of the facility is shown in Figure 1-1, Topographic Map of the L.E. Carpenter Facility, Wharton, New Jersey. The facility comprises Block 301, Lot 1 and Block 703 Lot 30 on the tax map of the Borough of Wharton.

L.E. Carpenter has owned this facility since 1943. The facility was designed and operated as a manufacturing facility for vinyl wall coverings from 1943 to 1987. It is currently utilized as subleased warehouse space.

Figure 1-1 depicts the major features of the site and illustrates the immediate environmental setting. The site occupies approximately 14.6 acres northwest of the intersection of the Rockaway River and North Main Street. The site is situated within a commercial/industrial area. The Rockaway River borders the site to the south; a vacant lot lies to the east; and a large compressed gas facility (Air Products Inc.) borders the site to the northeast. Additional industrial sites are located to the south of the site. The residential portion of the Borough of Wharton is separated from the site by Ross Street, which is located on the northwestern side of the site.

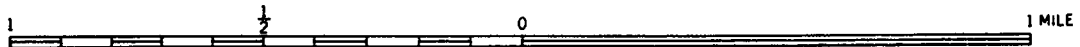
The site is located within the Dover Mining District, which is one of the oldest mining districts in the country. Iron ore was extracted from three mines in the vicinity of the site from the late 1800's to the early 1900's. The Washington Forge Mine and the West Mount Pleasant Mine were located directly on what is currently the L.E. Carpenter property (Sims, 1958). The Washington Forge Mine was located in the approximate area of Building 16. The West Mount Pleasant Mine was located approximately 170 feet northeast of the Washington Forge Mine, in the general vicinity of Building 15. The Orchard Mine was located on the southern side of the Rockaway River, approximately 200 feet south of the Washington Forge Pond. The Washington Forge and West Mount Pleasant mines operated intermittently between 1868 and 1881. The Orchard Mine was operated intermittently between 1850 and 1910. Tailings from the Washington Forge and West Mount Pleasant mines are thought to have been disposed of on-site. A forge which serviced these and other local mines was operated at the Orchard Mine site. Shipment of ore from and through the site may have adversely affected soil and groundwater quality.

The L.E. Carpenter facility was involved in the production of Victrix vinyl wall coverings from 1943 to 1987. The making of vinyl wall coverings involves several manufacturing processes which were carried out in the various buildings comprising the L.E. Carpenter



SCALE 1:24000

Reference: USGS Dover, NJ Quadrangle



**WESTON**  
MANAGERS DESIGNERS/CONSULTANTS

**L.E. CARPENTER SITE  
WHARTON, NJ.**

**FIGURE 1  
SITE LOCATION MAP**



facility. The process involved the generation of waste solvents including xylene and methyl ethyl ketone, the collection of solvent fumes via "smog-hog" condensers, the collection of particulate matter via a dust collector, and the discharge of non-contact cooling water to the Rockaway River. During the period of operation, the L.E. Carpenter facility was operated in accordance with prevailing waste disposal regulations and environmental statutes. The facility operated several air pollution control devices permitted by NJDEPE and maintained a New Jersey Pollution Discharge Elimination System (NJPDES) Permit for the discharge of non-contact cooling water.

From approximately 1963 until 1970, L.E. Carpenter disposed its wastes, including a polyvinyl chloride (PVC) waste material, into an on-site impoundment. L.E. Carpenter submitted a report to NJDEPE in October 1979 regarding the characterization of the PVC waste material disposed of in the impoundment and an evaluation of remedial alternatives for the impoundment. The report indicated that a chemical analysis of the PVC waste material collected from the impoundment on 25 July 1979, showed the presence of the following compounds: di-n-butyl phthalate, diethyl phthalate, phenol, antimony, barium, cadmium, copper, magnesium, lead and zinc.

In response to sampling efforts conducted by the NJDEPE in 1980 and 1981, L.E. Carpenter and NJDEPE entered into an Administrative Consent Order (ACO) in 1982, which was amended in 1983.

Pursuant to the requirements of the 1982 ACO and the 1983 Addendum, L.E. Carpenter took the following actions: In April and May 1982, L.E. Carpenter removed over 4,000 cubic yards of waste from the impoundment; thereafter L.E. Carpenter implemented a groundwater quality monitoring program. On 11 May 1984, L.E. Carpenter began removing immiscible chemical compounds from the top of the water table beneath the site.

On 26 September 1986, an additional ACO was entered into which superseded the 29 January 1982 ACO and the Addendum of 24 February 1983 except that all requirements of the Groundwater Decontamination Plan dated 31 October 1983, as approved with conditions by NJDEPE on 26 January 1984, were incorporated. Under the terms of the Amended ACO, effective 26 September 1986, L.E. Carpenter initiated a RI/FS of its former manufacturing facility in Wharton, New Jersey facility.

The active production of vinyl wall covering ceased in 1987. Since that time, the portion of the facility east of the railroad tracks has been inactive. Access is currently restricted to the area east of the railroad track by an 8-foot chain-link fence. The buildings west of the railroad tracks have been subleased as warehouse space and light manufacturing.



### 1.3 Existing Ecological Risk Assessment

Potential ecological effects associated with the L.E. Carpenter Site have been previously estimated (Weston Ecological Risk Assessment, 1992). Exposure to contaminants of concern were evaluated in concert with toxicological data to estimate the degree of ecological risk to aquatic receptors in the Rockaway River. Factors that entered into this assessment included contaminant source locations, local topography and habitat, physical and chemical properties of contaminants, and an evaluation of potential receptors. This evaluation resulted in the development of a conceptual site model which indicates that aquatic organisms are potentially exposed to contaminants at concentrations in excess of biologically derived ambient water quality criteria. However, this report also discussed the uncertainties associated with the results, underscoring the need for an empirical determination of the biological integrity of the modeled receptors.

### 1.4 Habitat Description

In the vicinity of the site, the Rockaway River is a third order stream. The basin consists of a series of northeast-southwest trending valleys filled with thick sequences of glacial deposits. Headwaters originate in the Berkshire Valley and flow southwest, parallel to the trend of the valley until reaching the main west-east Rockaway Valley approximately one mile upstream of the site. The Washington Forge Pond is immediately upstream of the site and is an impoundment created for hydroelectric power generation.

The Rockaway River immediately downstream of the Washington Forge Pond flows through a modified channel prior to passing under the North Main Street overpass and a railroad trestle. Between the trestle and the spillway, the Rockaway River flows through a channelized corridor. In this area, the river is approximately 30 feet wide and ranges to one foot in depth. The canopy cover is less than 50 percent and the riparian vegetative community has been reduced in extent and species composition by adjacent structure and development. The river substrate is relatively homogenous and consists of sand to cobble sized particles. The Washington Forge Pond dam releases epilimnetic water to the Rockaway River. This type of release typically results in elevated water temperatures during the summer and reduces the load of suspended material present in the water.

Downstream of the trestle and adjacent to the northwest corner of the site, the channel broadens to form a basin, presumably designed to receive water from a now defunct hydroelectric operation. This portion of the channel flows sluggishly for approximately 125 feet along a concrete wall that forms the southern border of the site. The basin is isolated from the main channel of the Rockaway River by a narrow island that extends for approximately 75 feet downstream from the outfall of the hydroelectric operation. The main channel of the Rockaway River is approximately 25 feet wide and ranges to two feet in depth. The substrate is highly variable and consists of sand to bolder sized particles.



Although restricted somewhat by the steep valley wall to the south and the site to the north, the canopy cover is approximately 80 percent and is variable in species composition.

Adjacent to the northeast corner of the site, the Rockaway River flows in a northerly direction through a series of braided channels. This network expands in complexity as the floodplain increasingly broadens to form a riparian wetland. With the exception of size, the rivulets forming the braided network are similar to the upstream channel. The channels typically range from five to ten feet in width and to one foot in depth. The canopy cover is almost 100 percent in this area. Due to the relatively consistent gradient, the water velocity in this area remains similar to that in the upstream channel. The substrate consists of fine sand to cobble sized particles. In a number of locations, small cobble impoundments impede the flow and small pools are formed in the channel immediately upstream.

Approximately 400 feet downstream of the site, the rivulets coalesce into a single channel. A large manmade cobble and boulder impoundment is present approximately 30 feet downstream of this confluence which forms a pool ranging to five feet in depth. Further downstream, the Rockaway River flows through a well defined channel with a substrate consisting of sand to cobble sized particles. In some areas, extensive development has encroached upon the riparian vegetative community and canopy cover is less than 25 percent.

### 1.5 Project Objective

The focus of this ecological assessment is the Rockaway River adjacent to and in the vicinity of the L.E. Carpenter Site. The benthic macroinvertebrate community will serve as a surrogate for aquatic ecosystem integrity and shifts in the taxonomic structure or function will be evaluated with respect to habitat constraints.

## 2.0 INVESTIGATIVE STRATEGY

### 2.1 Overview

A benthic macroinvertebrate community is comprised of a heterogenous assemblage of animal groups (taxa) that inhabit the sediment or live on or in substrate associated with the sediment. As a consequence of this intimate contact with the sediment, this community integrates exposure to sediment as well as water column contaminants and is frequently employed as an indicator of environmental quality. In this investigation, the benthic macroinvertebrate community will be sampled up- and downstream of the L. E. Carpenter Site. Structural and functional attributes of this community will be analyzed in light of the habitat available at the reference as well as each downstream location.

### 2.2 Sample Locations

To the extent possible, sampling locations will be situated in areas of similar habitat. In particular, habitat parameters important to the study objectives include substrate composition, the extent and composition of riparian vegetation, flow velocity, and watershed features. Consistency among these parameters will permit inferences to be made concerning biological integrity. Sample locations will be assigned a number sequentially starting from the upstream extent of the study area. The designation of samples collected from the Rockaway River will be numbered 1 through 6 and correspond to locations upstream (1 and 2), adjacent to (3 and 4), and downstream of the site (5 and 6). These sampling locations are shown on Figure 2.

Two upstream reference locations (1 and 2) will be established in the Rockaway River drainage basin based on the results of previous sampling. The reference locations will be utilized to normalize the biological assessment to the best attainable situation. Biological integrity at downstream sampling locations will be compared to reference location integrity and evaluated with respect to habitat quality parameters. One reference will be located immediately upstream of the site, and a second will be located upstream of Washington Forge Pond. The use of multiple reference locations are intended to overcome potential problems related to habitat differences immediately downstream of the Washington Forge Pond spillway and contaminants present in the Rockaway River not attributable to the site (Smith et.al., 1987). The two locations adjacent to site (3 and 4) will be utilized to identify and assess the potential biological impairment adjacent to the site. In the event biological impairment is observed, the two downstream locations (5 and 6) will be use to document biotic recovery. Macroinvertebrates collected from these locations will be processed only if biological impairment is observed.

# **LEGEND**

- PROPERTY LINE
- ▲ APPROXIMATE MACROINVERTEBRATE SAMPLING LOCATION



AIR PRODUCTS & CHEMICALS, INC.

WHARTON ENTERPRISES, INC.

DRAINAGE DITCH

ROSS STREET

RAILROAD RIGHT OF WAY

NORTH MAIN STREET

INFILTRATION GALLERY

ROCKAWAY RIVER

FLOW

100 YARDS  
500 YARDS

▲ SAMPLE 5  
▲ SAMPLE 6

SAMPLE 4

▲ SAMPLE 3

**WESTON**  
MANAGERS DESIGNERS/CONSULTANTS

L.E. CARPENTER AND CO.  
WHARTON, NEW JERSEY

**ECOLOGICAL ASSESSMENT  
SAMPLING LOCATIONS**

FIGURE 2	DATE June 15, 1992	REVISION 0
-------------	-----------------------	---------------

From Original by GEOENGINEERING

0 50' 100'  
Approximate Scale

WASHINGTON  
FORGE  
POND

DAM  
SAMPLE 2

▲ SAMPLE 1

#9

#8

#15

#17

#16

#14

#13

#12



## 2.3 Habitat Assessment

### 2.3.1 In Situ Water Quality

In-situ water quality will be determined at each sampling location with a Hydrolab Surveyor II field monitoring instrument. The instrument will receive a pre and post operation calibration, and will be operated as per Hydrolab Corporation Surveyor II Operating Manual (Revision A, February, 1985). A post-use calibration will also be performed to ensure that data collected was not adversely effected by sensor fouling or instrument drift. Parameters to be measured will include dissolved oxygen, conductivity, pH, oxidation-reduction potential, temperature, and salinity.

### 2.3.2 Riparian and Instream Habitat

A habitat assessment matrix based on stream classification guidelines for Wisconsin (Ball, 1982) and methods for evaluating stream riparian and biotic conditions (Platts et al., 1983) will be used. This habitat evaluation procedure is intended to support the macroinvertebrate survey. Various habitat parameters will be rated and then be totaled and compared to the reference locations to provide a final habitat ranking. All parameters will be evaluated for each sampling location and will be weighted to emphasize the most biologically significant parameters. The highest scores will be awarded to locations with best quality habitat.

Habitat parameters pertinent to the assessment of habitat quality will be placed into primary, secondary, and tertiary categories. Primary categories are those that characterize the stream microscale habitat and have the greatest influence on the structure of the biological community. The primary categories include characterization of the bottom substrate and available cover, estimation of imbeddedness, and estimation of flow or velocity and depth regime. The secondary characteristics measure the macroscale habitat and include characteristics such as channel morphology, channel alteration, bottom scoring and deposition, and stream sinuosity. Tertiary characteristics evaluate riparian habitat and include bank stability, bank vegetation and streamside cover.

## 2.4 Macroinvertebrate Biological Survey

### 2.4.1 Introduction

The biological survey of the Rockaway River will focus on the benthic macroinvertebrate community, supplemented by a cursory examination of the periphyton and macrophyte community. At each location, macroinvertebrates will be collected from riffle areas and from coarse particulate organic matter. The riffle samples will be quantitative in nature and will be collected from five discrete areas at each sampling location. The evaluation of these

samples will proceed in a phased approach. Three samples will initially be processed through the evaluation procedure. Should the data thus generated provide sufficient resolution to meet the study objectives, the remaining samples will not be processed. If additional resolution is required, the samples will be processed and the larger data set analyzed. One qualitative sample will be collected from each location.

#### **2.4.2 Riffle Area Macroinvertebrate Field Methods**

The riffle area will be sampled to evaluate the scraper and filterer functional feeding groups. Riffle areas with relatively fast water velocity and cobble to gravel substrates are generally the most diverse and productive areas of streams. Five samples from discrete areas of comparable habitat will be collected from each location using a kick net. In order to permit comparisons, an equivalent level of effort will be expended at each area and location. Macroinvertebrates will be collected from a 1 square yard riffle area consisting of a heterogeneous assortment of gravel to cobble sized particles. A kick net, measuring approximately 2 feet high and three feet wide, with 500 micron mesh openings will be used to collect benthic macroinvertebrates. The vertical portion of the net frame will be positioned firmly on the substrate with the net extended by the current in a downstream direction. A sampling area of approximately 1 square yard will be established immediately upstream of the net. The stream bottom within this area will be disturbed by overturning rocks and substrate to a depth of approximately five inches. Organisms thus dislodged will be swept into the net by the current.

#### **2.4.3 Coarse Particulate Organic Matter Macroinvertebrate Field Methods**

One sample of coarse particulate organic matter will be collected from each location to evaluate the shredder functional group. Sampling will be qualitative in nature and will involve collecting a composite sample of any of a variety of forms of coarse particulate organic matter including plant parts, leaves, needles, twigs, bark, or fragments of these. Potential sample sources include leaf packs and shorezone areas where these materials may collect. A variety of sources and forms will be collected opportunistically from several areas at each location. Care will be taken to avoid the collection of fully decomposed material as this tends to have the lowest shredder representation.

#### **2.4.4 Periphyton and Macrophyte Field Methods**

Periphyton will be sampled at each location to provide information concerning the energetic basis of the stream ecosystem. Attached and crustose forms of nonvascular plant and animal material will be qualitatively collected with forceps and pipets from hard substrate material and composited into a single sample. The distribution, abundance, and species composition of macrophytes will be noted on the field data sheets.

#### 2.4.5 Field Processing of Samples

Kick net and coarse particulate organic matter collections will be partially processed in the field. At all locations, the net contents or the coarse particulate organic matter will be placed in a shallow white pan with a small volume of water. Organisms clinging to the net fabric will be removed with forceps and added to the pan contents. To prevent damage to the organisms during transport and ease the sorting task, large debris, stones, and other extraneous material will be removed after ensuring that they are free of attached or clinging organisms. The remaining material will be placed in one quart plastic containers and preserved with Kahle's solution.

Periphyton samples will be preserved with a four percent formalin solution.

#### 2.4.6 Laboratory Processing of Macroinvertebrate Samples

A 200 organism subsample will be used as a time-saving sorting procedure for use with the kick net sample. The subsampling method is based on that used for Hilsenhoff's Biotic Index (Hilsenhoff, 1987) and is similar to that used by New York DEC (Bode, 1988) and in Arkansas (Shackleford, 1988). The subsampling procedure will consist of evenly distributing the sample in a gridded pan with a light-colored (preferably white) bottom. Grids will be randomly selected and all organisms within selected grids will be removed, until at least 200 organisms have been selected from the sample. This method of subsampling provides a representative estimate of the benthic fauna as well as a consistent unit of effort. The specific procedure used will be as follows:

1. The sample will be thoroughly rinsed in a No. 35 mesh (500-micron) screen to remove preservative. Any large organic material (whole leaves, twigs, algal or macrophyte mats) not removed in the field will be rinsed and visually inspected. Since Kahle's solution contains alcohol, it will be necessary to soak the sample contents in water for 15 minutes to hydrate the benthic organisms, thus preventing them from floating on the water surface during sorting.
2. The sample contents will be placed in a large, flat pan with a light-colored bottom. The bottom of the pan will be marked with a numbered grid pattern, each block in the grid measuring approximately 2 inches square. Sample too large to be effectively sorted in a single pan will be thoroughly mixed in a container with some water, and half of the homogenized sample placed in each of two gridded pans. Each half of the sample will be composed of the same kinds and quantity of debris and an equal number of grids will be sorted from each pan, in order to ensure a representative subsample.

3. Just enough water will be added to allow complete dispersion of the sample within the pan; an excessive amount of water will allow sample material to shift within the grid during sorting. The sample material will be evenly distributed within the grid.
4. A random numbers table will be used to select a number corresponding to a square within the gridded pan. All organisms will be removed from within that square; this process will continue until the total number sorted from the sample is at least 200. Any organism which is lying over a line separating two squares is considered to be in the square containing its head. In those instances where it is not possible to determine the location of the head (worms for instance), the organism will be considered to be in the square containing the largest portion of its body. Any square sorted must be sorted in its entirety, even after the 200 count has been reached. If many of the organisms are very small and it appears that the potential for missing individuals is great, an illuminated 5X magnifier will be used to facilitate the sorting procedure.

All benthic macroinvertebrates in the subsample will be identified to the lowest positively identified taxonomic level (generally genus or species), enumerated, and recorded on a laboratory bench sheet. It is anticipated that varying levels of taxonomic resolution will be attained; separations may range from order to species, with most identifications made to the generic level. The size and life history stage, and state of taxonomic knowledge of the group will determine the level of identification. The organisms will be identified using appropriate taxonomic references (for example, Edmunds et al., 1976; Wiggins, 1977; Pennack, 1978; and Merritt and Cummins, 1984). A representative subsample will be identified by a second individual to meet the QA/QC requirements of the taxonomic analysis.

#### 2.4.7 Laboratory Processing of Periphyton Samples

Wet mounts of periphyton samples will be scanned using multiple magnifications ranging from 5X to 300X. Several random aliquots of the sample will be evaluated for the presence of microorganisms. In particular, the relative abundance of diatoms, green algae, microarthropods and fungi will be determined. This evaluation will be qualitative in nature.

### 2.5 Data Analysis

Based on observations made in assessing habitat, water quality, physical characteristics, and the biological survey, a preliminary judgement on the presence or absence of biological impairment will be made. This will be followed by an integrated analysis of the benthic macroinvertebrate data. Several community population and functional parameters will be examined in light of the habitat data collected. The analysis will include an assessment of numerical abundance, dominance and diversity, and functional feeding types. Using the raw benthic data, a numerical value will be calculated for each of eight metrics. Each metric

has a different range of sensitivity measuring a slightly different component of community structure. Calculated values will then be compared to values derived from the reference site.

Analysis of the trophic structure and functional integrity of the benthic macroinvertebrate community will involve a descriptive summary of functional feeding groups. The classification of an organism into a group will be based on morphological mechanisms of food acquisition, behavioral characteristics of an organism, and the physical/biochemical characteristics of the food item. Taxa will be assigned a feeding group based on literature descriptions of mouth parts, gut contents, and ecology (Cummins, 1973; Cummins and Klug, 1979; and Merritt and Cummins, 1984). Once a functional feeding group classification list has been established, it will be incorporated into the analysis for computation of metrics. Care will be taken to note the presence of early instars which may represent different functional feeding groups from later instars. In some cases, the degree of taxonomic resolution will not permit the placement of a taxa into a single group. In this case, fractional shares for that taxa will be assigned to each potential feeding group (Barbour and Cummins, 1989).

Five functional feeding groups will be considered, including shredders, filterers, gatherers, scrapers, and predators. Shredders consume coarse particulate organic matter composed primarily of decomposing vascular plant material. The microflora associated with this material is an important component of the total energy assimilated by this group. Collectors feed on fine particulate organic matter either by filtering this material from the water column (filterers), or by gathering it from deposits and sediments (gatherers). Scrapers possess specialized mouth parts that enable them to feed on periphyton. The periphyton community grows on submerged mineral and organic substrates and is composed of bacteria, protozoa, and algae. Predators are secondary consumers feeding on animal tissue.

The data collected in the 200 organism riffle subsample and the coarse particulate organic matter sample will be summarized according to the information required for each metric and entered on a data summary sheet. Each metric result is given a score based on percent comparability to the reference station. Evaluation of biological condition will be based on comparison to the reference condition. The habitat assessment, physical characterization, and water quality data will aid in the evaluation process. The metrics used to evaluate the benthic data and their significance are described below.



## Riffle Sample

### Metric 1. Species Richness

The number of taxa reflects the health of the community through a measurement of the variety of taxa (total number of genera and/or species) present. Taxa richness generally increases with increasing water quality, habitat diversity, and/or habitat suitability.

### Metric 2. Modified Hilsenhoff Biotic Index

This metric summarizes the overall pollution tolerance of the benthic arthropod community with a single value (Hilsenhoff, 1987). Tolerance values range from 0 to 10, increasing as water quality decreases. The Modified Hilsenhoff Biotic index was developed as a means of detecting organic pollution in communities inhabiting rock or gravel riffles, and has been modified to include non-arthropod species as well, on the basis of the biotic index used by the State of New York (Bode, 1988).

### Metric 3. Ratio of Scraper and Filterer Functional Feeding Groups

The scraper and filterer collector functional feeding group ratio reflects the riffle community foodbase and provides insight into the nature of potential disturbance factors. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source. The predominant feeding strategy reflects the type of impact detected.

### Metric 4. Ratio of Ephemeroptera, Plecoptera, and Trichoptera (EPT) to Chironomidae

The EPT and Chironomidae abundance ratio uses relative abundance of these indicator groups as a measure of community balance. Good biotic condition is reflected in communities having a fairly even distribution among all four major groups and with substantial representation in the sensitive groups such as Ephemeroptera, Plecoptera, and Trichoptera. Skewed populations having a disproportionate number of the generally tolerant Chironomidae relative to the more sensitive insect groups may indicate environmental stress (Ferrington 1987).

### Metric 5. Percent Contribution of Dominant Taxon

The percent contribution of the numerically dominant taxon to the total number of organisms is an indication of community balance at the lowest positive taxonomic level. (The lowest positive taxonomic level is assumed to be genus or species in most instances.) A community dominated by relatively few species would indicate environmental stress.

#### **Metric 6. EPT Index**

The EPT index generally increases with increasing water quality. The EPT Index is the total number of distinct taxa within the orders Ephemeroptera, Plecoptera, and Trichoptera. This value summarizes taxa richness within the insect orders that are generally considered to be pollution sensitive.

#### **Metric 7. Community Similarity Indices**

Community similarity indices are used in situations where reference communities exist. The following will be used in this investigation:

- **Community Loss Index** - Measures the loss of benthic species between a reference station and the station of comparison.
- **Jaccard Coefficient of Community** - Measures the degree of similarity in taxonomic composition between two stations in terms of taxon presence or absence.
- **Pinkham and Pearson Community Similarity Index** - Measures the degree of similarity in taxonomic composition in terms of taxon abundances and can be calculated with either percentages or numbers.

#### **Coarse Particulate Organic Matter Sample**

#### **Metric 8. Ratio of Shredder Functional Feeding Group and Total Number of Individuals Collected**

This metric is also based on the functional feeding group concept. The abundance of the shredder functional group relative to the abundance of all other functional groups allows evaluation of potential impairment as indicated by the coarse particulate organic matter-based shredder community. Shredders are sensitive to riparian zone impacts and are particularly good indicators of toxic effects when the toxicants involved are readily adsorbed to organic matter and either affect the microbial communities colonizing organic matter or the shredders directly (Cummins 1987).

### **2.6 Quality Assurance**

The collection, preservation, and analysis of all samples will follow methods detailed in the guidance documents cited in Section 1.1.



Sampling equipment, flow measuring devices, and other field monitoring instruments will be calibrated and used as per the manufacturers instructions. All calibration data will be documented in site log books.

All samples will be collected, transferred, stored, analyzed, and disposed of using chain-of-custody procedures. Chain-of-custody records will be maintained and will contain the site name, sample location, sample identification number, date collected, sample container, and preservative. Upon completion of a chain-of-custody record, the transfer of sample custody will be accomplished by signing the "relinquished by" and "received by" sections.

Habitat assessments, and field collections will be performed by the same person(s) to ensure consistency and all field procedures and observations will be documented.

Sample processing in the laboratory will be performed by the same person(s) to ensure consistency in sorting. All sample residue will be retained for the life of the project and used to determine sorting efficiency and precision. Subsampling will be performed using a random numbers table. The taxonomic identification will be confirmed by a second individual familiar with regional taxa.



### **3.0 PROJECT SCHEDULE**

**This project will be completed within 16 weeks following initiation of the work plan. The field work will start within three weeks following approval of the work plan and will be completed in one week. Laboratory processing will require five weeks. A draft report will be provided to NJDEPE 12 weeks following completion of the field work.**



#### 4.0 REFERENCES

Ball, J. 1982. Stream Classification Guidelines for Wisconsin. Wisconsin Department of Natural Resources Technical Bulletin. Wisconsin Department of Natural Resources. Madison, Wisconsin.

Barbour, M.T. and K.W. Cummins, 1989. The use of functional feeding groups to assess community balance. Presented at the 1989 Annual Meeting of the North American Benthological Society. Guelth, Ontario.

Bode, R.W., 1988. Quality Assurance Work Plan for Biological Stream Monitoring in New York State. New York State. New York State Department of Environmental Conservation.

Cummins, K.W., 1973. Trophic Relations of Aquatic Insects. Ann. Rev. of Entomol. 18:183-206.

Cummins, K.W. and M.J. Klug, 1979. Feeding Ecology of Stream Invertebrates. Ann. Rev. Ecol. Syst. 10:147-172.

Cummins, K.W., 1987. Appalachian Environmental Laboratory, University of Maryland, Frostburg, Personal Communications.

Edmunds, G.F., Jr., S.L. Jensen and L. Berner, 1976. The Mayflies of North America and Central America. University of Minnesota Press, Minneapolis, MN. 330 pp.

Ferrington, L.C., 1987. Collection and Identification of Floating Exuviae of Chironomidae for Use in Studies of Surface Water Quality. SOP No. FW 130A. U.S. EPA, Region VII, Kansas City, Kansas.

Hilsenhoff, W.L., 1987. An Improved Biotic Index of Organic Stream Pollution. Great Lakes Entomol. 20:31-39.

Hydrolab Corp. 1985. Hydrolab Surveyor II Operating Manual, Revision A.

Merritt, R.W. and K.W. Cummins, eds., 1984. An Introduction to the Aquatic Insects of North America, Second Edition. Kendall/Hunt Publishing Co. Dubuque, Iowa.

Pennack, R.W., 1978. Fresh-Water Invertabrates of the United States. Protozoa to Mollusca (Third Edition). John Wiley and Sons, Inc., New York, New York 628 pp.



Platts, W.S., W.F. Megahan, and G.W. Minshall, 1983. Methods for Evaluating Stream, Riparian, and Biotic Conditions. General Technical Report INT-1389. U.S. Department of Agriculture, U.S. Forest Service, Odgen, Utah.

Roy F. Weston, Inc. 1991. L.E. Carpenter Remedial Investigation Feasibility Study, Section 6.0 Ecological Risk Assessment.

Shackleford, B., 1988. Rapid Bioassessment of Lotic Macrintertebrate Communities: Biocriteria Development. Arkansas Department of Pollution Control and Ecology, Little Rock, Arkansas.

Smith, J.A., P.T. Harte, and M.A. Hardy, 1987, Trace-metal and organochlorine residues in sediments of the upper Rockaway River, New Jersey, Bull. Environ. Contam. Toxicol.

US DOE, 1986, Users Manual for Ecological Risk Assessment DOW 40-740-78.

US EPA, 1981, ERL-RTP Procedures Manual-Level 1 Environmental Assessment - Biological Tests EPA 600/8-81-024.

US EPA, 1983, Protocols for Bioassessment of Hazardous Waste Sites. Corvallis ERL. EPA-600/2-83-054.

US EPA, 1988, Review of Ecological Risk Assessment Methods Office of Policy Planning and Evaluation. EPA/230-10-88-041.

US EPA, 1989, Risk Assessment Guidance for Superfund Volume II Environmental Evaluation Manual Interim Final EPA/540/1-89/001.

US EPA, 1989, Ecological Assessment of Hazardous Waste Sites, A Field and Laboratory Reference EPA/600/3-89/013.

US EPA, 1989, Rapid Bioassessment Protocols for use in Streams and Rivers, Benthic Macroinvertebrates and Fish, Office of Water, EPA/444/4-89-001.

US EPA, 1990, Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters, Office of Research and Development, EPA/600/4-90/030.

Wiggins, G.B., 1977. Larvae of the North American Caddisfly Genera (Trichoptera). Univ. Toronto Press. Toronto, Ontario.